13. Worse than a congestion charge: Paris traffic restraint policy

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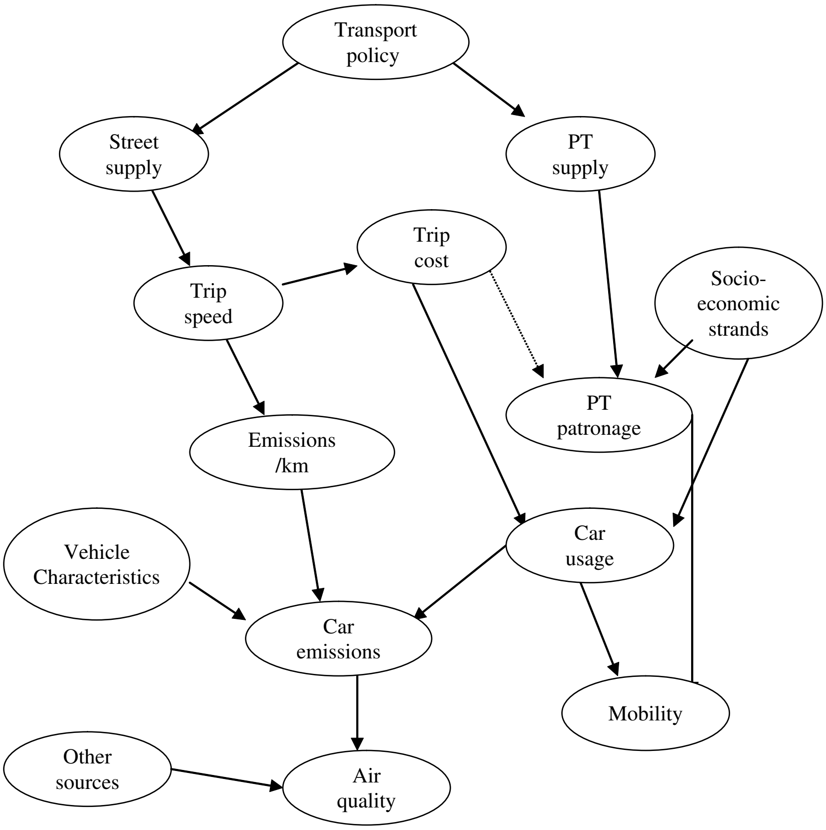
1 INTRODUCTION

Congestion charges are good in theory, but can be bad in practice. Studying the case of London, Prud'homme and Bocarejo (2005) concluded that implementation costs were higher than the time gains for remaining car users (net of the welfare loss of evicted car users) and the time gains for bus users and environmental gains. Studying the case of Stockholm, Prud'homme and Kopp (2006) reached a similar conclusion. However, the shrinking of road space policy followed in Paris is much worse: it is bad in theory and bad in practice.

Let us begin by clarifying the meaning of 'Paris'. The expression is used, and can be used, to designate two different realities: the 'Paris agglomeration', and the 'Paris municipality'. The Paris agglomeration is an economic and social entity with a population of 11 million people, which functions as a largely integrated labour market, in part thanks to good highway and public transport systems. It comprises over 1,000 municipalities, the basic French politico-administrative unit. The Paris municipality, with about 2 million people, is one of them. It is obviously the most important one, and the heart of the agglomeration, but it represents only a fifth of the agglomeration in terms of population, and much less in area. The many studies that compare Paris defined as a municipality (2 million people) with London (7 million people) or New York (9 million people) in terms of age distribution or employment structure or productivity are meaningless. In this chapter, we shall use the word 'Paris' to mean the Paris municipality.

Why focus on the Paris municipality, when the significant socio-economic – and transport – realities relate to the Paris agglomeration? The answer is because a number of policy decisions are taken at the municipality level. In 2001, a new team was elected in the Paris municipality, consisting of Socialists, Communists and Greens, and headed by Bertrand Delanoe, a Socialist. Although the Socialists are the dominant force, they need the support of the Greens. Green politicians were put in charge of transport policy (and of environmental policy), and the transport policy followed reflects their priorities rather than those of the Socialists (although the latter did endorse it). It is this policy which is examined in this chapter, by comparing data for 2000 with data for 2004. Obviously, outcomes are not entirely the result of the policies followed. They are also influenced by all sorts of factors or trends that we shall try to identify and take into consideration. Figure 13.1 presents the analytical framework used.

The impact of the transport policy on street supply (a reduction) led to changes in car speeds (a reduction) which had consequences on car trip costs (an increase). In principle, transport policy could also impact on public transport supply, which would lead to changes in public transport



Note: PT = Public transport.

Figure 13.1 Analytic Framework

patronage, which would combine with changes in car trip costs to produce changes in car usage. As we shall see, this did not happen in Paris. It follows that changes in car usage (a reduction) can be attributed to the changes in car trip costs (and probably also to changes in exogenous socio-economic factors) that also affected public transport patronage. Changes in car usage and in public transport patronage let to changes in mobility (a decrease).

Changes in speed also had an influence on unit pollutant emissions, that is emissions per kilometre (an increase). Combined with changes in car usage, and with the exogenous changes in vehicle characteristics, this led to changes in pollutant emissions (a decrease). Combined with changes in other pollution sources, this led to changes in air quality.

Section 2 offers a brief description of the transportation situation in 2000 as a benchmark, before the new policy was introduced. Section 3 continues with a presentation of the policies undertaken. The 2000–04 changes are then presented and analysed, and related to the policy undertaken. This makes it possible to estimate the costs and benefits of the policy (Section 4). Section 5 concludes.

2 PARIS TRANSPORT IN 2000

It is useful to try to characterise the transport situation before the new policy was introduced. To this end, five points can be emphasised.

Rich Public Transport Supply

A first point relates to the abundance and quality of public transport supply. With 16 lines and 380 metro stations (of which 327 are in the Paris municipality), and a high frequency, the Metro offers 68 million seat-km per day. With 60 lines and 1,270 bus stops, much lower frequency and capacity, Paris municipality buses offer 8 million seat-km per day (suburban bus lines offer more than twice that amount). The picture is completed by trains, in particular the RER (high-speed regional trains), linking suburban areas to the Paris municipality.

Important Street Network

Thanks in particular to the arterial roads created in the late nineteenth century by Baron Haussman, Paris is also well endowed with boulevards and avenues, more so than most similarly dense cities. The road network comprises about 1,500 km, including about 400 km of 30-metre wide arterials. There are about 750,000 parking spaces, 75 per cent of which are private (underground private garages or parking lots). Free street parking accounts for about 7 per cent of the total. To this road network should be added the 35 km of ring road that circles the Paris municipality (and legally belongs to it). This ring road is the most travelled road in Europe. It is estimated that about 65 per cent of its traffic is Paris-municipality related (the rest being non-Paris to non-Paris traffic).

Decrease in Car Traffic

Contrary to what most people believed and to what was repeatedly stated by politicians, car use in the Paris municipality did not increase in the 1990s, but decreased. Two different sources give different estimates of this decrease: 0.5 per cent per year according to the 1991 and 2001 transport surveys, 2 per cent per year according to the Paris municipality Observatoire des Transport (Transport Observatory). This decrease is not surprising: during the period, the Paris municipality population stagnated and employment declined. The number of trips with Paris as the origin and/or destination could hardly not diminish.

Balanced Modal Distribution

Surprisingly, it is not easy to allocate Paris municipality trips to the various modes. The transport survey gives useful orders of magnitude, but it excludes trips by non-Paris region residents (all tourist trips, for instance, are ignored) and most goods vehicle trips; also it does not discriminate between the various public transport modes. RATP (Régie autonome des transports Parisians), the Paris transport authority, publishes detailed statistics on public transport, but little is known about car trips The Transport Observatory monitors car movements only on 190 of the 1,500 km road network. Table 13.1 presents the modal distribution of trips in the Paris municipality. It is in passenger-km per day, not in number of trips, and it ignores walking, because this is more meaningful for an analysis of transport policy. It also ignores goods transport, a more serious limitation.

It appears that slightly more than half of motorised passenger transport in the Paris municipality is taking place in dedicated lanes, mostly underground. The other half takes place in the streets of Paris, which, in addition, carry practically all goods vehicles. For the most part, public transport and cars travel in different lanes, and are therefore not in conflict. The exception is busses, which in 2000 accounted for 4 per cent of passenger transport, or 9 per cent of transport in the streets of Paris – less if we consider total transport including goods vehicles.

Table 13.1 Modal distribution of motorised transport in Paris municipality, 2000

Transport mode	Pass-km/day (m)	%
Below ground		
Metro	17.7	29.0
Train (SNCF + RER)	14.2	23.3
Total	31.9	52.3
Above ground		
Bus	2.7	4.4
Motor vehicles	24.7	40.6
Taxis	0.6	0.9
Motorbikes	1.1	1.8
Total	29.1	47.7
Total (% rounded)	61.0	100.0

Sources: Authors' estimates, based on data from the Transport Observatory and from RATP.

Table 13.1 describes only motorised transport. It does not include bicycles, whose importance is small (estimated to be 0.2 per cent of passenger-km on the streets and 0.1 per cent of all passenger-km). The share of Paris municipality residents is not known precisely, but it is likely to be less than 50 per cent. It is higher for buses, and probably the Metro, but lower for cars (particularly on the ring road) and for the RER and trains.

Declining Pollution

According to repeated claims by the media and politicians, air pollution was deteriorating rapidly. According to a December 2000 survey, 94 per cent of Paris agglomeration residents were convinced that air pollution had deteriorated during the previous decade. However, the reality was the exact opposite. Air pollution declined markedly in Paris in the 1990s, a fact that could easily be verified on the website of Airparif, the agency in charge of monitoring air quality in the Paris region (www.airparif.asso.fr). Table 13.2 compares the rates for six pollutants in 1991 and 2000. These figures relate to the Paris agglomeration but are representative of the Paris municipality, particularly for the assessment of change. The table shows that in the nine years preceding the traffic restraint policy, the decline was significant for all primary pollutants; indeed, lead disappeared altogether from Paris air. Only ozone, a secondary pollutant, increased. CO_2 emissions also increased, but CO_2, a greenhouse gas with worldwide effects, is not monitored at the local level.

Table 13.2 Pollution in Paris, 1991 and 2000

	1991 (mgr/m^3)	2000 (mgr/m^3)	Change (%)
Sulphur dioxide (SO_2)	27	9	−67%
Nitrogen oxides (NOx)	105	70	−33%
Benzene	4.9	1.9	−61%
Ozone (O_3)	19	35	+84%
Particulates	34	15	−56%
Lead	0.16	0	−100

Source: See airparif.asso.fr.

3 POLICIES UNDERTAKEN

What Policy Changes Were Introduced by the Municipal Team Elected in 2001?

Public transport supply

The first point worth noting is that policy changes had little effect on the supply of public transport. As shown in Table 13.3, public transport increased only marginally between 2000 and 2004. The number, frequency and comfort of the Metro, buses and trains did not increase significantly. The Paris municipality is not responsible for this, because it does not control public transport supply on its territory. This supply is determined by STIF (Syndicat des Transports de l'Île de France) which was then controlled by the government (it is now controlled by the Paris Île de France region), with the SNCF (Société nationale des chemins de fer français), the national rail company, and RATP, the national bus and Metro company, as executing agencies. The Paris municipality, with the help of STIF, did invest in a tramway line, but this line was only recently opened and is not considered here, and is obviously not considered here.

Anti-car policies

The policy followed was not pro-public transport, it was anti-car. It was clearly articulated in 1999 by Ms Chantal Duchêne, who was in charge of transport at DREIF, the Paris region directorate for equipment of the central government (and simultaneously elected as a Green): 'It will be necessary to reduce the space available for automobiles. Thanks to bus lanes, cycle tracks, and wider pavements, car speeds will decrease, making other modes more attractive' (*Journal du Dimanche*, 9 September 1999).

Table 13.3 Public transport in Paris, 2000 and 2004

	2000	2004	Change (%)
Metro			
Length of lines (km)	167.7	168.4	+0.4
Stations	326	327	+0.2
Seat-km per year (billion)	24.8	26.2	+5.6
Buses			
Lines	59	59	0.0
Length of lines	565.5	567.8	+0.4
Seat-km per year (billion)	3.0	3.1	+3.3

Source: RATP.

The deputy mayor in charge of the environment in the new municipal team said the same thing in more forceful terms: 'It is only by making it hell for car drivers that we will force them to give up their damned cars'. It is this traffic restraint policy, announced in no uncertain terms before the elections, that has been implemented since 2001.

The main thrust of the policy was the reduction in road space for private cars and goods vehicles. Dedicated bus lanes were increased and expanded. In many cases, the widening of these bus lanes, and the construction of 60 cm high walls to separate them from the rest of the road, resulted in the elimination of one, and in some cases two, car lanes. Four-lane avenues were transformed into three- or even two-lane avenues. Rue Beaubourg, was downgraded from three lanes to one lane (on one particular stretch, but it is that stretch that regulates speed and flow). Road space was also reduced in streets not served by any bus, by means of cycle tracks, or by the widening of pavements. Some streets were also closed to car traffic. The relative importance of this road space policy – proudly put forward by the municipal team – is difficult to assess. Fifteen per cent (one-third of space on 40 per cent of streets in terms of traffic) might be a likely estimate.

Another element of the policy relates to parking, which was made more difficult. Street parking fees for 'residents' (of the Paris municipality or of the area) were greatly reduced (by 80 per cent), encouraging car-owning residents to leave their cars parked in the street. Simultaneously, parking fees for non-residents, including the many suburban dwellers working or shopping in the Paris municipality, were increased (by 30 per cent). Private construction of underground parking space was also discouraged (but this measure will take time to be effective). As a result, the vacancy rates of parking spaces, which were low, decreased by about 50 per cent.

Table 13.4 Paris bus speed and patronage, 2000 and 2004

	2000	2004	Change (%)
Speed (km/h)			
On 16 best protected lines	12.4	12.2	−2
On rest of network	12.8	12.7	−1
On entire network	12.7	12.5	−2
Traffic (m trips/year)			
On 16 best protected lines	135	134	−1
On rest of network	219	214	−2
On entire network	355	348	−2

Source: Calculated from RATP data.

Pro-cycle policies

Additional cycle lanes were created, and bicycles were allowed to use dedicated bus lanes. Since this could have reduced the speed of buses, bus lanes were widened from three to 4.5 metres, in order to enable buses to overtake bicycles more safely.

Anti-two-wheeler policies

Unlike bicycles, two-wheelers (motorbikes, scooters) were not allowed to use bus lanes, and parking was made more difficult. Fines for illegal parking increased by 180 per cent between 2003 and 2004.

Policy Outcomes

Decline in bus speed and patronage

One could have expected increased and widened dedicated bus lanes to produce an increase in the bus speeds, in the quality of the bus service, and consequently in bus patronage. However as Table 13.4 shows, this did not happen. The table is based on bus line by bus line RATP data.[1] Even on the 16 better protected lines, speeds actually worsened.

This might sound surprising. One is used to seeing buses in their dedicated lanes, often empty, and travelling faster than the cars in the congested adjacent lanes. Four tentative explanations can be offered. First, the speed at which buses travel when they are moving is much higher than the average speed at which people are driven in buses, because buses stop at traffic lights and above all because they stop to let passengers get on and off; a 20 per cent increase in peak speed would result in only an 8–9 per cent increase in average speed (and a much lower increase in origin to destination speed for users, because it would not affect access and waiting time). Second, one bus in a bus lane can delay the following buses; at a bus stop, the time lost by one bus cannot be less than the time lost by the preceding bus. Third, the management of certain intersections has been made more complicated by dedicated bus lanes; in some places, traffic lights go green successively for cars and then buses, automatically increasing waiting time for both types of vehicles. Finally, bus lanes, unlike the Metro, are not entirely dedicated, and many buses lose in 'ordinary' traffic jams the time they might gain in their dedicated lanes.

What is certain is that bus patronage did not increase. Since bus supply did not increase either in quantity (no additional lines) or in quality (no increased speed or frequency), this stagnation is hardly surprising. Bus demand could have been sensitive to increases in the cost of car travel. But it seems that the cross-elasticity of bus demand to the price of alternative modes is very low. A large share of car traffic comes from non-Paris municipality residents, for whom buses are not an attractive alternative – you never see a plumber from a suburban municipality boarding a bus with a sink under his arm. The bus, with its frequent stops, is well adapted to very short trips (the average length of a bus trip is 2.2 km). Metro and car trips are on average much longer.

Decrease in car speed and traffic

The shrinking of road space and other road traffic impediments resulted in lower speeds and therefore less traffic. The causal link should be emphasised. Why would traffic decline, if not because of lower speed and more generally higher costs of car transport? It did not decline because of improvements in the quality of public transport: there were no such improvements. It did not decline because of increases in fuel prices: between 2000 and 2004, fuel prices in France actually decreased (by about 8 per cent, largely because the euro appreciated relative to the dollar). It must have declined because of lower speeds, and also because of a trend in the decline in the demand for road transport in Paris.

Traffic decline between 2000 and 2004 is known, although imperfectly. The Transport Observatory, which monitors traffic on about 200 km of streets (50 per cent of main streets and 15 per cent of all streets), puts it at 13.3 per cent. Let us accept this number. It must be decomposed into two parts: the first reflects the general change in population and activity, and the second is the consequence of the policy under analysis. We have two numbers reflecting past trends: one, from previous transport surveys, would put the decline at 2 per cent (over the four-year period), and another one, from the Transport Observatory, would put the decline at 8 per cent. We shall assume a 'natural' 4.3 per cent decline. The impact of the transport policy can therefore be estimated to have produced a 9 per cent traffic decline.

Speed decline between 2000 and 2004 is unfortunately not well documented. The Transport Observatory estimates a 6.3 per cent decline, or 1.6 per cent per year. This is very hard to believe. First, it does not square at all with the daily experience of Parisians, particularly of workers and enterprises involved in goods transport, who report a marked deterioration in driving conditions and time required for delivery. Second, it is hardly compatible with the established stagnation of speeds on bus lines. Above all, it cannot explain the measured traffic decline.[2] This is why we propose our own estimates of changes in car speeds, based on price elasticities of the demand for car travel. Our starting-point is the price elasticity calculated on the case of London: –0.83 (Prud'homme and Bocarejo, 2005), which is already rather high relative to accepted urban car transport elasticities. The price considered is the generalised cost, consisting of the money cost, plus the time cost. The money cost is estimated to be 0.15 €/km. The time cost is a function of speed s, the number of passengers per car n, and the value of time t. Taking $n = 1.3$ persons per car, and $t = 9$ €/h (the French official value of time), we have for the generalised cost c:

$$c = 0.15 + 9*1.3/s,$$

which yields:

$$s = 11.7/(c - 0.15).$$

Combined with given values of elasticities of traffic to cost, this makes it possible to estimate the decline in speed associated with a given decline in traffic. This is done in Table 13.5, for two estimates of elasticities (−0.8 and −0.5) and two estimates of traffic reduction (−13 per cent and −9 per cent).

Table 13.5 is built upon the hypothesis – reasonable in the absence of an improvement in public transport supply – that it is the reduction in speed, and the cost increase that comes with it, that explain traffic reduction. It appears that speed reductions (as a percentage) are always higher than traffic reductions. This is not surprising, since time is the main component of generalised cost, and elasticities of speed relative to cost are greater than –1 (more precisely: between –1 and 0). The speed change associated with the recorded traffic decline of 13 per cent is –17 per cent with a –0.8 elasticity. The decline is greater (–25 per cent) with a not implausible elasticity of –0.5. If one considers the traffic reduction induced by the policies (–9 per cent), then speed reduction must be –12 per cent, with a –0.8 elasticity, and –18 per cent with a –0.5 elasticity. We shall retain this –12 per cent estimate of speed change. Note that it is a very conservative estimate, the lowest of our four estimates, based on a high elasticity (–0.8) and a low traffic decline (–9 per cent).

Table 13.5 Speed reduction associated with various traffic reductions, 2000 and 2004

	$e=-0.8$	$e=-0.5$
Speed in 2000 (km/h)	17.4	17.4
Generalised cost in 2000 (€/km)	0.822	0.822
With a 13% traffic decline (2004)		
Change in generalised cost	+16.2%	+26%
Generalised cost 2004 (€/km)	0.955	1.036
Speed in 2004 (km/h)	14.5	13.1
Change in speed 2000–04	−17%	−25%
With a 9% traffic decline (2004)		
Change in generalised cost	+11.25%	+18%
Generalised cost 2004 (€/km)	0.914	0.970
Speed in 2004 (km/h)	15.3	14.3
Change in speed 2000–04	−12%	−18%

Note: Generalised costs are costs per vehicle-km. To obtain cost per passenger-km, divide by 1.3.

Source: Authors' calculations.

Table 13.6 Rail patronage, 1996–2004 (%)

	1996–2000	2000–2004
Metro	+15.9	+5.5
RER (high-speed subways)	+7.3	+17.9
Suburban trains	+15.0	+8.4

Increase in rail usage

Metro patronage, and even more so RER and suburban train patronage, increased in the 2000–04 period, as shown in Table 13.6.

RER and suburban train numbers must be treated with caution, because they include changes in suburb-to-suburb trips that have nothing to do with the Paris municipality. The increase in Metro travel, more than 5 per cent, is unambiguous. The question is whether and to what extent, it is the result of the Paris municipality traffic restraint policy. Some car drivers discouraged by increased traffic jams generated by this policy must have abandoned their car for the Metro (since they did not do so for the bus). It is nevertheless noteworthy that the increase in Metro patronage was more important in the preceding period (1966–2000) than in the period studied. This suggest that the hoped-for modal shift, if it existed, was probably very limited.

Increase in two-wheeler usage

A marked increase in the usage of motorised two-wheelers (motorbikes, scooters and so on) took place in the 2000–04 period. However, available data on this issue leave much to be desired. Where two-wheeler usage is measured by the Transport Observatory, a 10 per cent increase took place. For people who travel in the Paris municipality, this number seems an underestimate.

Increase in bicycle usage

According to Transport Observatory records, bicycle usage in the Paris municipality increased by 41 per cent between 2000 and 2004. It would have increased from 60,000 passenger-km to 85,000 passenger-km, that is from 0.10 per cent to 0.14 per cent of total passenger transport.

Negative impact on pollution

In 2004, relative to 2000, and as a consequence of the policies followed, there are fewer vehicles in Paris streets driving at lower speeds. All other things equal, this has a negative impact on pollution in Paris. For most pollutants (and for fuel consumption as well) emissions per km are a function of speed. The general shape of this relationship is well known: it is U-shaped. Emissions per km are high at very low speed, then they decrease, reaching a low plateau in the 40–80 km/h range, then increase significantly. The precise equation of this relationship is not well known. Part of the difficulty is related to the notion of 'speed'. A vehicle driving 'at 20 km/h' in a city is not a vehicle driving at a constant 20 km/h. It is a vehicle driving at 35 km/h, then slowing down, then accelerating, then stopping, then accelerating. From an emissions viewpoint, it is the profile of the speed curve that counts, not its average. This is why emission norms are defined for standard profiles, although these profiles are too simplistic to be realistic. Estimating the elasticity of emissions to 'speed' is therefore a difficult exercise.

A study undertaken by L'Union Technique de l'Automobile, du Motorcycle et du Cycle (UTAC), the agency that controls the conformity of new vehicles to EU norms, on behalf of Lucas Diésel, a diesel engine manufacturer, compared emissions for similar vehicles driven according to (i) the European norm speed profile, resulting in a 19 km/h average speed, and (ii) an actual speed profile, resulting in an 11.5 km/h average speed. We used these measurements to produce the elasticities presented in the first two rows of Table 13.7. These high elasticities are questionable. The purpose of the study was to compare diesel and gasoline engines, and it was designed to that effect, not to compare emissions at different speeds: therefore the recorded differences could reflect differences in speed profiles as

Table 13.7 Elasticities of emissions to speed, various pollutants

	Gasoline (calculated)	Diesel (calculated)	Average (retained)
CO	−15.9	−2.3	−4.6
Particulates	–	−5.4	−2.7
HC	−8.7	−3.1	−3.0
NOx	−4.3	−1.5	−1.5

Note: Actual emisions were measured for same vehicles driven at 19 km/h according to the EU speed profile, and at 11.5 km/h according to an effective speed profile. Retained values are 50% of the average diesel–gasoline numbers.

Source: Calculated from measurements made by UTAC for Lucas Diésel.

Table 13.8 Impact of policies on motor-vehicle pollutant emissions, 2000–2004 (%)

Traffic change	Effective	Policy induced
Traffic change	−13	−9
Speed	−17	−12
Emissions		
CO	+68	+50
Particulates	+38	+29
Hydrocarbons	+44	+33
NOx	+22	+16
Average	+43	+32

Note: The notion of 'average' has no rigorous meaning and is calculated only to give a broad order of magnitude.

Source: Calculated on the basis of Table 13.7.

much as or more than differences in average speeds. To be on the safe side, for the rest of our evaluation we retained values equal to half the calculated elasticities (we also gave an equal weight to gasoline and diesel cars, a reasonable assumption in the case of the Paris municipality).

This made it possible to produce Table 13.8, which shows the policy-induced changes in motor-vehicle pollutant emissions resulting from the combination of decreased traffic and speeds. Note that these numbers do not take into account the changes in the pollution efficiency of vehicles, and the fact that vehicles were cleaner in 2004 than in 2000, the third determinant of emissions as discussed below. Table 13.8 does not signify that vehicle emissions

Table 13.9 Changes in pollution levels in Paris, 2000/1996 and 2004/2000 (%)

	2000/1996	2004/2000
NOx	−25	−17
SO_2	−40	−22
Particulates	−25	−13
Benzene	−62	−15

Note: Data refer to the Paris agglomeration. The pollutants selected are those for which comparable data are available for 1996, 2000 and 2004.

Source: See airparif.org.

actually increased between 2000 and 2004, rather that the impact of Paris municipality policies on emissions was negative. This was compounded by another factor: the replacement of cars by more polluting two-wheelers.

This policy-induced increase in motor-vehicle pollutant emissions did not result in an increase in registered pollution levels in the Paris municipality, for three reasons. First, motor vehicles are not the only source of pollution emissions: they account for only 17 per cent of particulate emissions, 19 per cent of HC and 49 per cent of NOx. Second, pollution levels recorded in the Paris municipality are a function of pollution emissions in the entire Paris agglomeration, including many municipalities that did not institute traffic restraint policies. The third reason, and the most important, is that the marked decline in pollution levels registered in the 1990s (and shown in Table 13.2, above) resulted from the spread of cleaner cars. Vehicles put on the market in 2000 were 10 to 20 times less pollutant than the vehicles put on the market in 1990. A stock effect slows down the decline in emissions, or rather spreads it over time. The considerable progress recorded in the preceding period continued in the 2000–04 period, as shown in Table 13.9.

It appears that air pollution levels in Paris continued to decrease in the 2000–04 period, although they did not decrease as fast as in the preceding four-year period. However, these numbers do not prove much. It is the argument developed that makes it possible to conclude that the traffic restraint policy had a negative impact. The contrast with London is striking. In London, as a result of the policy followed, there were fewer cars driving faster: two reasons for a decline in emissions. In Paris there were fewer cars driving more slowly: one reason for a decline and one – more powerful – for an increase.

We know that fuel consumption, and associated CO_2 emissions, increase with decreased speeds, but we have no estimate of the elasticity of CO_2 emissions to speed. Let us assume an elasticity of −1. This would imply a 12–17 per cent emission/km increase, to be combined with a 9–13 per cent decrease in traffic. This would produce a 3–4 per cent increase in CO_2 emissions. In view of the uncertainties surrounding this estimate, we shall assume that the policy has been roughly neutral relative to CO_2 emissions.

Mediocre performance in road safety

The decrease in speed, all other things equal, should have contributed to a decline in road accidents and in their seriousness. The increase in two-wheeler traffic certainly contributed to an increase in road accidents. Road safety must also be seen in a more global context. Table 13.10 shows road casualty figures in Paris and France, in 1996, 2000 and 2004.

The table shows that in the 2000–04 period, casualties decreased *more slowly* in Paris than in France as a whole, whereas in the preceding period it decreased *faster* in Paris than in France. One must also relate road accidents to road traffic, which declined in Paris wheras it increased in France. It appears that the number of casualties per vehicle-km decreased much less in Paris (12 per cent) than in France (44 per cent).

4 COSTS AND BENEFITS

We can now try to estimate the costs and the benefits of the traffic restraint policy introduced by the Paris municipality.

Table 13.10 Road casualties, Paris and France, 1996, 2000 and 2004

	Paris	France
Effective number		
1996	82	8,080
2000	67	7,643
2004	50	5,232
2000/1996 (%)	−18	−5
2004/2000 (%)	−25	−32
Number relative to traffic		
2004/2000 (%)	−12	−44

Note: Numbers relative to traffic are obtained by relating casualty to traffic changes: −13% in Paris, +6% in France.

Sources: Transport Observatory for Paris municipality; Union Routiere de France (URF) (www.urf.asso.fr) for France.

Financial Cost of Public Works Undertaken

Public expenditures on dedicated bus lanes are reported to amount to €65 million for the 2001–04 period. This is not an annual cost – which is the opportunity cost of capital (estimated to be 10 per cent) and the depreciation cost (also estimated to be 10 per cent), amounting to €13 million.

Loss for Car Users

Figure 13.2 shows the losses inflicted on car users. *D* (*q*) is the demand for road usage as a function of the unit costs of road usage. $I_1(q)$ indicates the unit cost of road usage as a function of road usage (road usage determines speed, which determines time spent and therefore time cost) in 2000, before the traffic restraint policy was instituted. Point A is an equilibrium point (with daily traffic of 15.5 million vehicles and a speed of 17.4 km/h, implying a unit cost of €0.822.

The traffic restraint policy shifts curve $I_1(q)$ to $I_2(q)$. A new equilibrium is found in B (with 13.5 million passenger-km and a speed of 14.5 km/h, implying a unit cost of 0.955 €/km). The welfare loss of car users – which is a welfare loss for society at large – is the area EBAD. It is equal to €1.92 million/day, or (by multiplying by 321 days) €618 million per year.

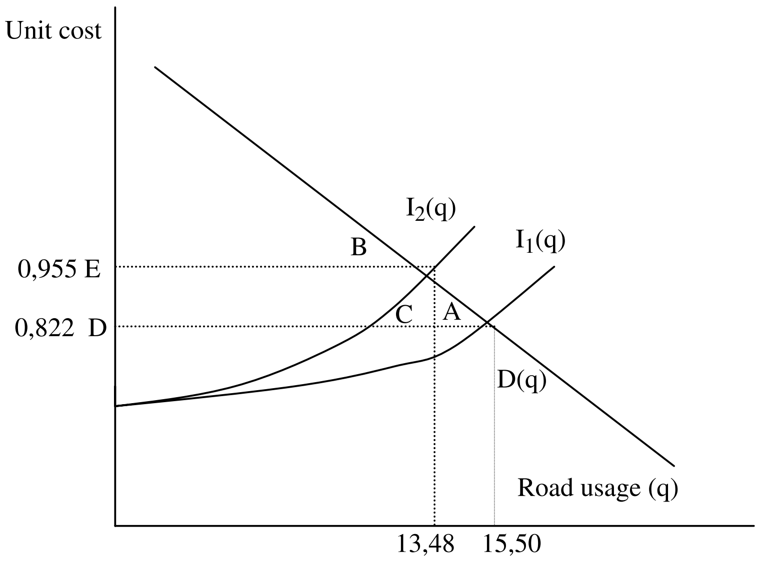


Figure 13.2 Losses associated with

Loss for Goods Delivery

Trucks and goods delivery vehicles in the Paris municipality in 2000 were estimated at 1.6 million vehicle-km per day. Let us ignore the fact that some of this has been eliminated (at a cost) and assume that this traffic is still present in 2004. Like cars, delivery vehicles take 0.69 minutes more to drive one km, which is a loss of 5.9 million hours per year. The value of time of goods delivery vehicles in Paris is not known, but cannot be less than €30 per hour, the same as for trucks in France at large. This represents a loss of €177 million per year. Note that this is a conservative estimate, which ignores completely the time lost because of increased parking difficulties.

Environmental Losses

We have seen that the traffic restraint policy led, all other things equal, to a 32 per cent–43 per cent increase in emissions (note that pollution levels decreased in 2000–04, and that this increase is an estimate, admittedly a crude one, of the impact of the policy). We can get an idea of the cost of this increase: the official Boiteux report values the cost of pollution in urban areas at €29 per 1,000 vehicle-km. This puts the cost of automotive pollution in 2000 in the Paris municipality at €144 million per year. A 32 per cent increase (to retain the lowest value) implies a cost – a surcharge – of €46 million per year.

Impacts for Bus and Bicycle Users

We have seen that these were no changes in bus speed or in bus frequency between 2000 and 2004 (this is consistent with the lack of change in bus usage). The policy has therefore been neutral for bus users.

If cycle usage increased, as it did (by 40 per cent), this means that the unit cost of usage declined, and that cyclists benefited from the policy. To get an idea of that welfare gain, let us assume that the per km cost in 2000 was equal to the per km cost of bus travel, that is €0.4 per/km. Let us further assume a −1 price elasticity of demand for bicycle travel. It follows that the unit user cost changed from €0.4 to €0.24, and that the daily welfare gain is €11,600 ((0.4–0.24)*(60,000 + 85,000/2)). Multiplying by 300 days, this amounts to €3.5 million per year.

Table 13.11 sums up these gains and costs. It is worth emphasising that these estimates have been obtained on the basis of a somewhat cautious hypothesis, and that the numbers presented are in the low range of estimates. Speed decline was estimated with a generous −0.8 elasticity. With a lower elasticity, it is likely that speed decline – and the associated costs – would be

Table 13.11 Costs and benefits of traffic restraint policy

	€m per year
Annual cost of investments	−13
Time loss for car users	−618
Time loss for goods delivery	−117
Environmental costs	−46
Cost/benefit for bus users	0
Benefit for bicycle users	+3
Total	−791

much larger. The values of time used (€9 per hour for passengers and €30 per hour for trucks) are low for the Paris municipality. In the study on the London charge, we utilised a €15.6 per hour value, which was criticised by many (see, for instance, Raux, 2005) as being too low. Obviously, higher values of time would produce higher car-user costs. The combination of a lower elasticity (−0.5) and a higher value of time (€12 per hr) would lead to costs well above €1.5 billion per year.

5 CONCLUSION

The purpose of this study was to analyse the effects of traffic restraint the policy introduced in 2001 in and by the Paris municipality, and to sketch a comparison with the policy introduced in London at about the same time – with the proviso that the geographic, economic, demographic, institutional, historic and political contexts are very different. Table 13.12 presents the results obtained.

The results do not speak highly in favour of the French policy. In both cases, the stated objective of reducing traffic has been achieved. But success in itself is not enough. One must also see how and at what cost it has been obtained. In London, it has been achieved by means of a toll, and accompanied by an increase in motor vehicle speed, generating a time gain for car users, and also for bus users, and a small environmental gain. In Paris, the main policy instrument has been the reduction in road space for motor vehicles, which led to a decrease in motor vehicle speed, but failed to increase bus speed and patronage. This policy generated a considerable time loss for car users and for goods delivery vehicles, and even environmental losses, without gains for public transport users. The only benefit seems to have been a small one for bicycle users: 0.4 per cent of all losses.

Table 13.12 Impacts of transport policies in London and Paris

	London	Paris municipality
Policy instruments	Toll More buses	Less road space Less parking
Physical impacts (%)		
Traffic	−9	−15
Car speed	−12	+17
Bus supply	0	+250 buses
Bus speed	0	+7
Bus patronage	0	+38
Car pollution	−34	+32
Economic impacts (€m/year)		
Implementation costs	−177	−13
Gains/losses for car users	+69	−618
Gains/losses for goods delivery	na	−117
Gain/losses for bus users	+31	0
Cost of bus subsidies	−5	0
Environmental gains/losses	+5	−46
Gain/losses for bicycle users	0	+3
Total	−73	−791

Note: The policy conducted in London concerns only a small part of London: the numbers given here relate registered changes to the magnitudes for the charge zone only. The changes in Paris are for 2000–04; in London they are for 2000–03, but the changes brought by the toll were mostly instantaneous. Time gains in London are calculated using a value of time of €16 per hr; and in Paris, €9 per hr.

Source: London: Prud'homme and Bocarejo (2005).

The downside of the London policy is the implementation cost, which is high, but which can be expected to decline over time.

Figures for Paris cannot readily be compared with those for London because the areas concerned by the two policies differ in size. It is nevertheless striking that the Paris policy largely generates only costs, whereas the London policy generates both costs and benefits. To reduce car traffic is not an objective *per se*, but a means to an end. What matters is to improve mobility and to reduce pollution. These objectives, which have not been reached in Paris, have been achieved in London, albeit at a high cost.

One should emphasise the limits of this study. It focused only on the short-term changes introduced by the traffic restraint policy. It therefore ignores long-term modifications, particularly on the location decisions of households and enterprises – which are probably important and negative. The study also focused only on changes introduced within the Paris municipality, ignoring the consequences of the policy on traffic in adjacent municipalities. The study nevertheless takes into account the costs and benefits (mostly costs) incurred in the Paris municipality by residents of other municipalities. These costs are important, since more than half are borne by non-residents. Our analysis also ignored gains and losses in reliability of transport time. On a given route, transport time is not constant: it is best represented by a distribution, with an average and a standard error. Users are sensitive to changes in the average (valued by time gained or lost). They are equally sensitive to changes in the standard error, which also varies. Taking into account these changes in reliability would increase car user gains in London, and also car user losses in Paris. In a recent paper, Santos and Bharkarb (2006) introduces a concern that we have also ignored. She says that the psychological cost of being caught in a traffic jam is so high that the value of time spent in traffic jams is much higher than the value of time spent in transport in general. The (difficult) introduction of this interesting consideration would increase gains in London and losses in Paris.

This study could therefore be significantly improved. But it is unlikely that these improvements would change the main lesson that can be derived from it. This lesson, familiar to any first-year economics student, is that price regulation is more efficient than quantity regulation. The London toll may not be the success often claimed, but the Paris traffic restraint policy is certainly a failure.

NOTES

1. We had some difficulty in obtaining these figures. A RATP official first denied their existence, so we obtained them 'laterally'. We published them in French papers, mentioning the initial refusal. RATP then explained that there had been a misunderstanding or a mistake, and pledged cooperation in the future.
2. Why accept the Transport Observatory estimates of traffic, and reject their estimates of speed? Both estimates come from point measurements. To measure the flow on a given route, the exact location of the measurement instrument does not matter much. To measure speed, however it does matter. Rue Beaubourg, for instance, is one lane for one stretch – which is nearly always jammed – then two lanes where traffic is more fluid. Measuring speed on the second stretch does not give a meaningful idea of the overall speed on the street.

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